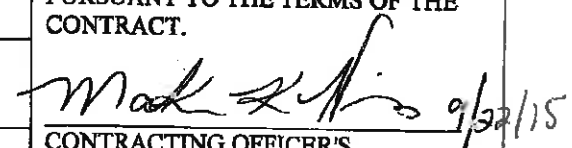
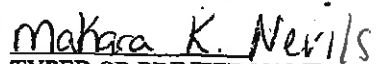



GODDARD SPACE FLIGHT CENTER		TASK ORDER (Instructions and Distribution on Reverse)		PAGE 1 OF 1																
1. CONTRACTOR: SSAI	2. CONTRACT NO.: NNG12HP06C	3. TASK/REVISION NO.: Task 3 Mod 1																		
4. JOB ORDER NO./PROJECT:	5. FLIGHT HARDWARE/SOFTWARE; CRITICAL GSA (IF, YES, OBTAIN BLOCK 16 CONCURRENCE): YES X NO	6. DESIGNATED FLIGHT ASSURANCE MGR.:																		
7. DESCRIPTION OF WORK TO BE PERFORMED (OBJECTIVES OR RESULTS DESIRED): Satellite Data Assimilation																				
8. TASK DOCUMENTATION REQUIREMENTS/DELIVERABLE ITEMS: See Attached																				
9. PERFORMANCE/MILESTONE SCHEDULE: February 1, 2015 – January 31, 2016																				
10. QUALITY ASSURANCE REQUIREMENTS:																				
11. TRAVEL, MATERIALS, ETC., KNOWN TO BE REQUIRED:																				
12. OTHER (FUNDING, NTE, HOURS, ETC.):																				
<table border="0"> <thead> <tr> <th></th> <th>FROM:</th> <th>BY:</th> <th>TO:</th> </tr> </thead> <tbody> <tr> <td>Estimated Cost</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fixed Fee</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Estimated Total Cost Plus Fixed Fee</td> <td>\$489,782</td> <td>\$13,911</td> <td>\$503,694</td> </tr> </tbody> </table>						FROM:	BY:	TO:	Estimated Cost				Fixed Fee				Estimated Total Cost Plus Fixed Fee	\$489,782	\$13,911	\$503,694
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13. TASK ORIGINATOR/MONITOR/CODE/PHONE: Steven Pawson		18. THIS TASK ORDER IS ISSUED PURSUANT TO THE TERMS OF THE CONTRACT.																		
14. BRANCH APPROVAL:	15. DIVISION CONCURRENCE:																			
16. CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE: Stephen Cohn		CONTRACTING OFFICER'S SIGNATURE/ DATE																		
17. CONTRACTOR SIGNATURE:		 TYPED OR PRINTED NAME																		

GODDARD SPACE FLIGHT CENTER		TASK ORDER (Instructions and Distribution on Reverse)		PAGE 1 OF 1
1. CONTRACTOR: SSAI	2. CONTRACT NO.: NNG12HP06C	3. TASK/REVISION NO.: CY4 0 03		
4. JOB ORDER NO./PROJECT:	5. FLIGHT HARDWARE/SOFTWARE; CRITICAL GSA (IF, YES, OBTAIN BLOCK 16 CONCURRENCE): YES <input type="checkbox"/> <input checked="" type="checkbox"/> NO	6. DESIGNATED FLIGHT ASSURANCE MGR.:		
7. DESCRIPTION OF WORK TO BE PERFORMED (OBJECTIVES OR RESULTS DESIRED): Atmospheric Composition				
8. TASK DOCUMENTATION REQUIREMENTS/DELIVERABLE ITEMS: See Attached				
9. PERFORMANCE/MILESTONE SCHEDULE: February 1, 2015 - January 31, 2016				
10. QUALITY ASSURANCE REQUIREMENTS:				
11. TRAVEL, MATERIALS, ETC., KNOWN TO BE REQUIRED:				
12. OTHER (FUNDING, NTE, HOURS, ETC.): Estimated Cost Fixed Fee Estimated Total Cost-Plus-Fixed Fee \$489,782				
13. TASK ORIGINATOR/MONITOR/CODE/PHONE: Steven Pawson		18. THIS TASK ORDER IS ISSUED PURSUANT TO THE TERMS OF THE CONTRACT.  CONTRACTING OFFICER'S SIGNATURE/ DATE Ayana A. Briscoe Contracting Officer		
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16. CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE: Stephen Cohn		TYPED OR PRINTED NAME		
17. CONTRACTOR SIGNATURE:				

Science Systems and Applications, Inc.
NNG12HP06C
Task Order Statement of Work

Task Order Number: CY4_03_Mod0

Task Order Title: Atmospheric Composition

1.0 Task Monitor (TM):

Name: Steven Pawson
Organization: GMAO:GMAO
Email Address: steven.pawson-1@nasa.gov

2.0 Description of Work to be Performed

Significant changes from CY2 to CY3:

1. Sub-Task D is scaled back.
2. Spurious QA requirements are deleted.

Changes from Mod 0 CY3 to Mod 1 CY 3:

1. Added travel to SPARC DA Workshop and EOS-Aura Science Team meeting, as indicated in red in Section 6.0 under Travel Requirements.

Change from Mod 1 CY 3 to Mod 2 CY 3:

1. Request contractor to correct an error in their response to Mod 1 CY 3, in which the cost for local travel to the SPARC DA workshop under Subtasks B and E was mistakenly estimated based on travel to Atlanta.

Changes from (Mod 2) CY3 to CY4:

1. Subtasks C and D are eliminated. Subtask E is re-named as subtask C.
2. A few elements of the remaining subtasks have also been eliminated. Significant changes to the remaining elements are indicated in red.

Sub-Task A: Chemistry-Climate Modeling

This sub-task supports the GEOS Chemistry-Climate Model (GEOS CCM) in GMAO, in collaboration with partners at GSFC and elsewhere. The main foci are the development and maintenance of atmospheric chemistry modules in GEOS-5, including the established "linearized chemistry" modules hosted under GOCART, the established Stratochem mechanism, the evolving GMI-COMEQ mechanism, and the emerging GEOS-Chem mechanism. An important role is acting as "gatekeeper" for the chemistry-related grid components in GEOS-5, including integration and testing of additional contributions that originate outside of GMAO. The following work is needed:

- Maintenance of the ESMF-based chemistry modules in evolving versions of the underlying GEOS-5 GCM, including test simulations that enable evaluation of the integrity of the CCM.
- Continuing to test chemistry modules in next-generation versions of the GEOS model, especially the cubed-sphere dynamical core as it is pushed to increasingly higher resolutions.
- Support the implementation of the GEOS-Chem grid component into the ESMF/MAPL framework of GEOS-5, [REDACTED] and contributing to the benchmarking of the code.
- Maintaining documentation of the chemistry components and information about how they should be used for scientific applications in GEOS-5.
- Conducting model simulations to support the research goals of the GMAO and its partners, mainly examining variations of the chemical composition of the atmosphere on interannual to multi-decadal scales, and how these changes interact with the radiative forcing of climate.
- Developing and maintaining an effective data management strategy for CCM model data.

Sub-Task B: Ozone Assimilation in GEOS-5

This sub-task supports the ozone assimilation component of GEOS-5/GSI, in order to enhance GMAO's ozone products in the near-real time analyses and reanalyses. A major goal is to obtain realistic ozone distributions in the upper troposphere and lower stratosphere, as well as viable distributions of tropospheric ozone columns. The following developments are required:

- Evaluation of the ozone record produced by MERRA-2, including aspects of observing system stability and the inherent stability of MERRA-2 ozone as a climate data record.
- Use the MERRA-2 system, or a variant, to examine the impacts of including additional limb-profile datasets (LIMS, UARS MLS, SABER, MIPAS) in future Earth System Reanalyses produced with GEOS-5, aiming at a start date of mid 2016.
- Continued testing and evaluation of the OMPS-LP dataset in GEOS-5, including assessments of its suitability for near-real time and reanalysis products.
- Implement and test total-ozone column information from TOMS, GOME-2, and the OMPS-Column dataset. Work with research scientists in GMAO to better characterize the spatial information content of the ozone-column observations and introduce this into GSI in a manner that best captures spatial structure in the resultant analyses. The work will include studies of the impacts of super-obbing and thinning the observations, as well as consideration of above-cloud ozone columns.
- Contribute to the development and assessment of ozone products that are produced using more complete chemistry modules than in present production systems. These include "Stratchem" as a means for detailed study of stratospheric ozone and "GEOS-Chem" as a means to examining ozone in an air-pollution context.
- Continue to transfer to production systems of newly developed ozone assimilation techniques, including the chemistry module in the model and enhanced analysis features. Evaluate and monitor products from the operational streams.

Sub-Task C: Stratospheric Investigations in GEOS-5

This subtask supports stratospheric meteorology in the GMAO. The work contributes to the assessment of the performance of the models and assimilation systems, the development of these systems to improve physical realism of the model and the data types ingested in the assimilation system, and the continual monitoring of system performance. The following work is required:

- Contribute to developments of the stratospheric analysis, with a focus on examining the performance of different data types (especially nadir radiances from AMSU-A and SSU) in both reanalyses (MERRA-2) and near-real-time systems. This will include software development to examine spatial characteristics of the radiance measurements, accounting for satellite orbits and instrumental viewing geometry. The work will also involve examination of model biases, including the stratopause structure and the morphology of the diurnal and semi-diurnal tides in the analysis system.
- Evaluation of the mean state and the planetary and gravity wave structures on the stratosphere of GEOS-5 systems, relating these waves to source mechanisms in the lower atmosphere. Assist in the scientific interpretation of the wave structures and their realism, including sensitivity to horizontal and vertical resolution in the models. Assess the realism of wave drag in GEOS systems, especially by comparing the resolved gravity wave drag structure in high-resolution models with the parameterized drag at lower resolutions.
- Contribute to regular evaluation of the stratospheric performance of GEOS ADAS products, including real-time production and systems that are candidates for production updates. Help develop new diagnostics and graphical displays for communicating information about GEOS-5 analyses and forecasts to the broader research field.
- Contribute to the assessment of transport error in the stratosphere of the GEOS models and assimilation systems, using existing tools and developing idealized models

3.0 Special Requirements

None

4.0 Performance/Milestone Schedule

The GMAO Contract Year 4 POP is February 01, 2015 - January 31, 2016

5.0 Deliverables/Reporting Requirements

Sub-Task A: Chemistry-Climate Modeling

Deliverables: Documented and tested model code, along with simulations using this code. The code will be maintained in the CVS repository designated by civil service staff. Results (datasets) from simulations will be made available to appropriate collaborators, archived for longevity, and visualized for scientific presentations and peer-reviewed publications, as specified by civil service staff.

Sub-Task B: Ozone Assimilation in GEOS-5

Deliverables: Documented and tested computer code for the GEOS-5 model and the GSI analyses, along with ozone distributions obtained using this code. Code will be maintained in the CVS repository designated by civil service staff. Datasets will be provided to collaborators, archived for longevity, and visualized for scientific presentations and peer-reviewed publications, as specified by civil service staff.

Sub-Task C: Stratospheric Investigations in GEOS-5

Deliverables: The contractor will be responsible for running existing codes and developing new software to analyze the GEOS systems. Results will be documented in various forms, including written reports, presentations to GMAO staff, and posted on the web, as specified by the TM

6.0 Other Information Needed for Performance of Task

Travel Requirements

Sub-Task A: Working meeting at Harvard University (Cambridge, MA; Sept 2015): one person, four days

Sub-Task A: Attend GEOS-Chem Science Team meeting at Harvard University (Cambridge, MA; May 2015): one person, four days

Sub-Task A: Attend Supercomputing Meeting in San Diego (San Diego, CA: Nov 2015): one person, five days

Sub-Task B: AGU Fall Meeting (San Francisco, CA: Dec 2015) : one person, six days

Sub-Task B: Working visit to JPL (Pasadena, CA: May 2014): one person, six days

Sub-Task C: AGU Fall Meeting (San Francisco, CA: Dec 2015) : one person, six days

Local travel for training purposes, not to exceed 5 person-days, will be authorized at the request of the TM or the GMAO Chief.

7.0 Data Rights

N/A

8.0 Safety

Staff on this task will comply with federal, state, local, and center safety regulations. This will be accomplished through management emphasis, technical training, and personal responsibility. Staff will participate in safety orientation and training in accordance with the contract Safety and Health Plan, and work within the requirements of that plan.

9.0 Risk

Contractor shall provide ongoing risk assessment and mitigation in performance of the Task Order. Priorities shall be re-evaluated as appropriate with the TM. Cost and schedule performance shall be assessed on a regular basis (no less frequently than monthly) and significant variations discussed and acted on in consultation with the TM and COTR.

10.0 Proposed Cost and Fixed Fee

In accordance with Paragraph B.5, of the contract, propose the Cost and Fixed Fee amount.